Intermediate Microeconomics

Chapter 9
Cost

1

Cost

- In order to attain production efficiency, firms need to be able to minimize cost
- In this chapter, we will look at how the firm chooses its optimal input combination for a given level of output
- We will distinguish between short and long run

2

Cost in the short run

- *Short run economic cost* = the minimal level of expenditures (measured in opportunity-cost terms) needed to produce a given amount of output in the short run
- In the short run, some factors are fixed (sunk costs) ⇒ no alternative uses ⇒ no economic costs ⇒ short-run economic cost entirely driven by the variable factor ⇒ *short-run variable cost*

3

Short-run variable cost

$$VC_{SR}(Q_0) = w \times L_a$$
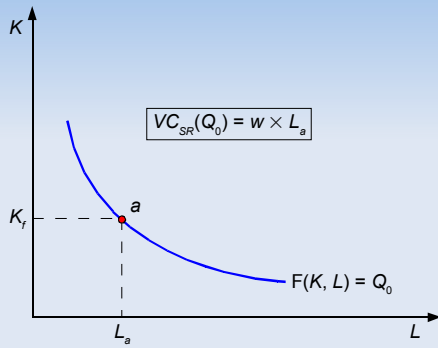
Other costs in the short-run

- *Short-run fixed cost* (FC_{SR}) = expenditures on factor that are fixed in the short run
- *Short-run total cost* (TC_{SR}) = sum of short-run variable and fixed costs

$$TC_{SR} = VC_{SR} + FC_{SR}$$

- Only short-run variable cost is an economic cost (remember that the economic cost of fixed inputs is zero) $\Rightarrow$ only VC_{SR} matters in short-run decisions

Short-run variable cost

- Properties:
  - must slope upward
  - level depends on the level of fixed factor (capital)
  - higher capital means lower short-run cost of labor (although it might sound counter-intuitive, remember it is because capital is fixed in the short run)

Short-run marginal cost

- *Short-run marginal cost* (MC_{SR}) = change in the short-run variable cost due to the production of one more unit of output (depends on technology)
- *Marginal factor cost* (MFC) = additional amount the firm has to pay for a factor when it hires one more unit of the factor
- One more unit of labor produces MPP_L more units of output ⇒ one unit of output is produced by $1/MPP_L$ units of labor ⇒
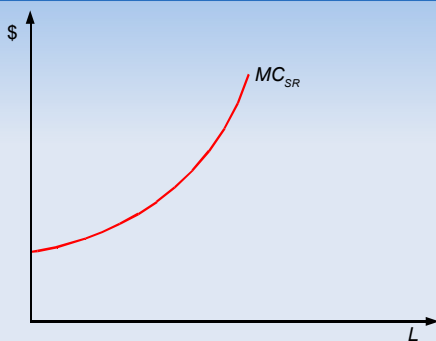
$$MC_{SR} = \frac{MFC_L}{MPP_L}$$

7

Marginal cost for a price taker

- Price taking firm ⇒ price of factors (wage) is not influenced by its demand (for labor) ⇒ $MFC_L = w$
- In this case, then:

$$MC_{SR} = \frac{w}{MPP_L}$$

- The higher the *MPP*, the lower the *MC*
  - diminishing *MPP* (of labor) ⇒ MC_{SR} is upward sloping
  - increasing *MPP* (of labor) ⇒ MC_{SR} is downward sloping

8

Short-run marginal cost

MC_{SR}

$ (vertical axis)

L (horizontal axis)
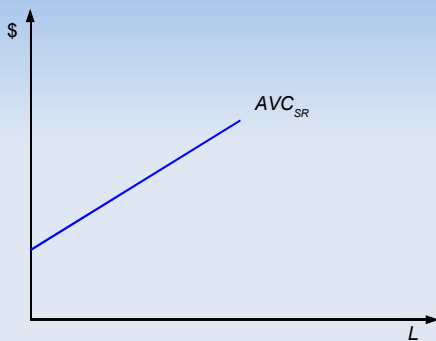
9

Average cost in the short run

- *Short-run average variable cost (AVC_{SR}) =* short-run variable cost per unit of output produced:

$$AVC_{SR} = \frac{VC_{SR}}{Q}$$

- Again, depends on marginal product:
  - increasing marginal returns $\Rightarrow AVC_{SR}$ is downward sloping
  - diminishing marginal returns $\Rightarrow AVC_{SR}$ is upward sloping

10

Short-run marginal cost

11

Other average costs

- *Short-run average fixed cost (AFC_{SR}) =* short-run fixed cost per unit of output produced:

$$AFC_{SR} = \frac{FC_{SR}}{Q}$$

- *Short-run average total cost (ATC_{SR}) =* short-run total cost per unit of output produced:

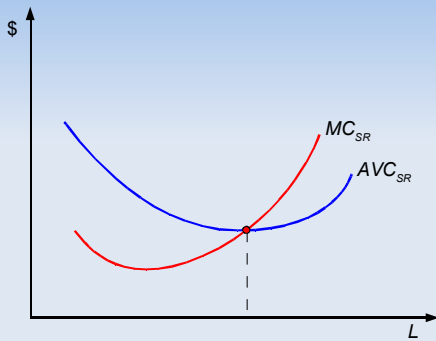$$ATC_{SR} = \frac{TC_{SR}}{Q} = AVC_{SR} + AFC_{SR}$$

12

Relationship between MC and AVC

- Since average variable cost and marginal cost are both derived from variable costs, they are related (hint: think of GPA):
  - when $MC_{SR} < AVC_{SR}$, AVC_{SR} falls
  - when $MC_{SR} > AVC_{SR}$, AVC_{SR} rises
  - $\Rightarrow MC_{SR}$ crosses AVC_{SR} at the point where AVC_{SR} is at a minimum

13

MC and AVC

14

Cost in the long run

- In the long run, all factors are variable $\Rightarrow$ expenditures on all factors are economic costs
- Also, firms can substitute among factors (since they are all variable)
- An input combination is *economically efficient* when it has the lowest opportunity cost among the input combinations that can be used to produced the desired output

15

Isocost lines and map

- *Isocost line* = line representing all input combinations that cost the firm the same amount
- *Isocost map* = set of all isocost lines that exist for a given set of factor prices
- Analogous to the budget line in utility theory (but a bit more complicated):
  - change in factor price tilts the line around the intercept for the *other* factor
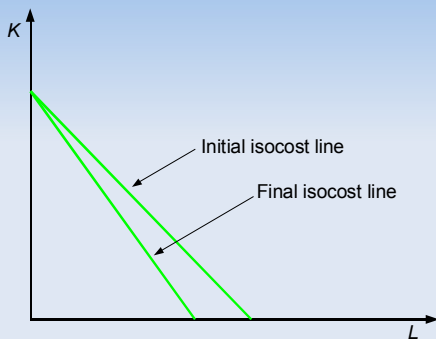 - no equivalent of "income limit"

16

Isocost map

K

Total cost = C_1

Total cost = $C_2 > C_1$

L
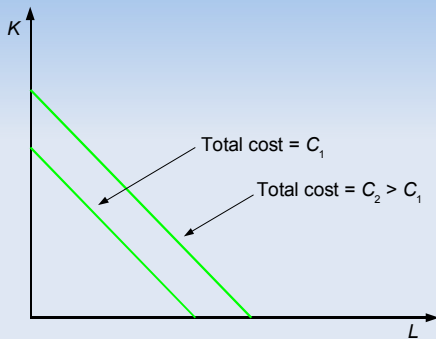
17

Effect of a wage increase

K

Initial isocost line

Final isocost line

L

18

The economically efficient input mix

- In utility theory, we combined the budget line with the indifference curves to obtain optimal consumption (consumer knew income)
- Here, we combine isocost lines with isoquants (firm knows production level)
- The difference is that what shifts around is the isocost line (the "budget constraint")!
- Optimal mix of inputs: the tangency point

19

The economically efficient input mix

$F(K, L) = Q$
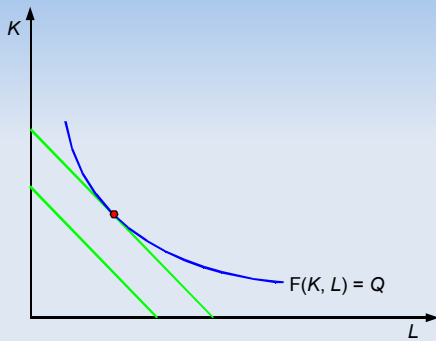
20

Algebraic interpretation

- At the optimum, isocost line and isoquant are tangent $\Rightarrow$ slopes are equal:

$$MRTS = \frac{w}{r} \Rightarrow \frac{MPP_L}{MPP_K} = \frac{w}{r} \Leftrightarrow \frac{MPP_L}{w} = \frac{MPP_K}{r}$$

- A price-taking firm should operate at a point where, at the margin, the marginal products of the inputs are proportional to their prices
- Thus, a manager can determine the optimal input combination without needing to know the production function (just the MPP's)

21

Comparative statics

- Increase in factor price:
  - isocost line tilts ⇒ firm substitutes away from the factor whose price has risen
  - total cost must rise
  - reverse happens when factor price falls
- Better technology:
  - shift isoquant inward
  - lower total cost
- Better quality or higher output: can be interpreted as a more costly technology (outward shift of isoquant)
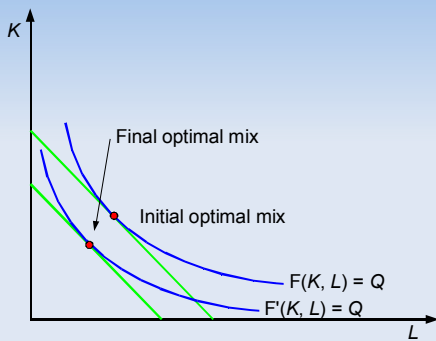
22

Increase in wage
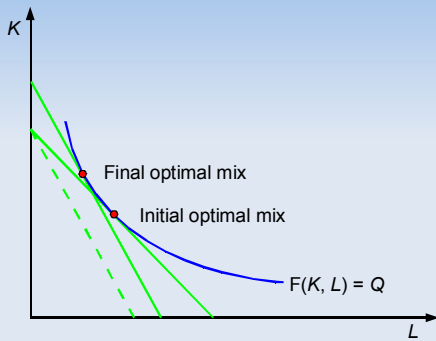
23

Better technology

24

Long-run costs

- *Long-run total cost* (TC_{LR}) = minimal level of total expenditures (measured in opportunity-cost terms) needed to produce a given level of output in the long run
- *Long-run marginal cost* (MC_{LR}) = the change in long-run total cost due to the production of one more unit of output
- *Long-run average cost* (AC_{LR}) = long run total cost per unit of output produced

25

Long-run vs short-run costs

- Fixed factors:
  - short run: some factors are fixed ⇒ any expenditure on them is not an economic cost
  - long run: all factors are variable ⇒ no fixed costs ⇒ higher economic costs than in the short run
- Substitution of factors:
  - short run: not (fully) possible because of fixed factors ⇒ higher costs
  - long run: fully possible ⇒ lower costs
- In the end: long-run costs can be higher *or* lower than short-run costs

26

Economies of scale and of scope

- *Economies of scale* = long-run average cost falls as output rises
  - production function has increasing returns to scale
  - when there are setup costs (have to be incurred regardless of how much output is produced)
- *Diseconomies of scale* = long-run average cost rises as output rises (e.g., decreasing returns to scale)
- *Economies of scope* = cheaper to produce two products in the same firm rather than in two specialized firms

27